Executive Summary of the Project Work Plan

DEVELOPMENT OF A PLAN FOR SUSTAINABLE FUTURE WATER SUPPLY

FOR

CAPE MAY COUNTY, NEW JERSEY

Prepared by the
New Jersey Department of Environmental Protection and U.S. Geological Survey
August, 2003

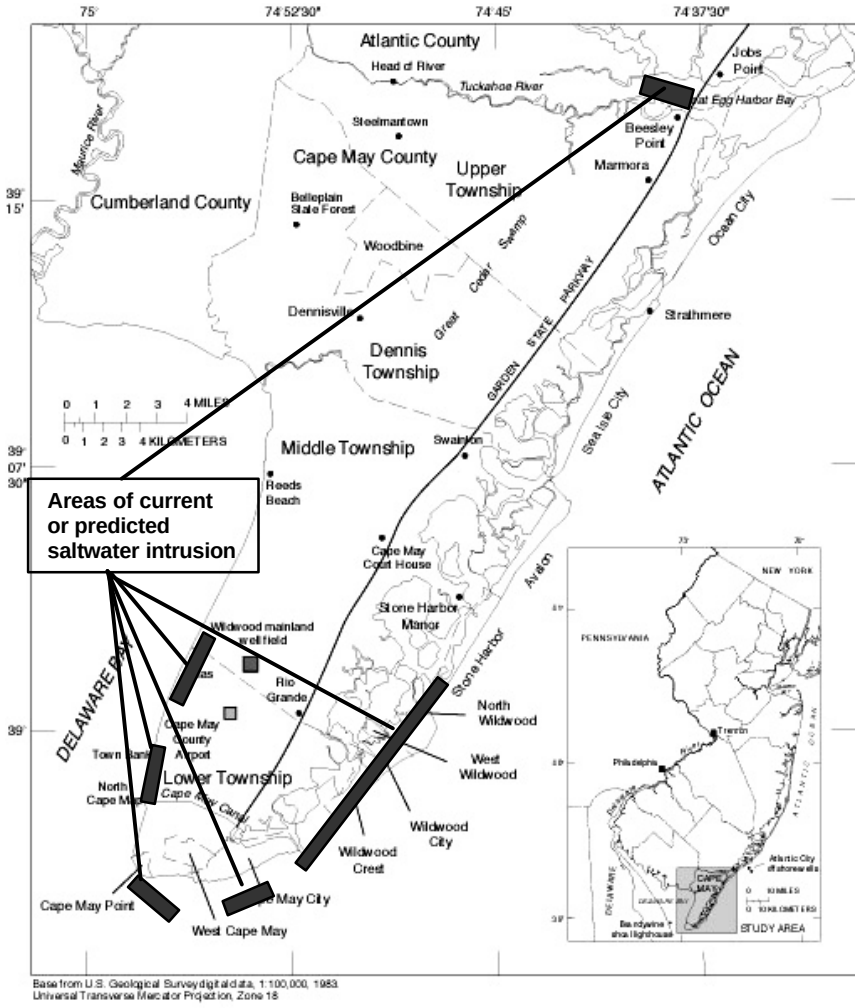
INTRODUCTION

This document describes the study that will determine the sustainable water supply in Cape May County capable of meeting current and future water needs of Cape May County, while minimizing adverse ground water or ecological impacts on the area. This study will meet the requirements of P.L. 2001 chapter 165 (Appendix A), also known as the Gibson Bill.

The Problem

The water withdrawals for public supply necessary for the increasing county population have caused declining ground-water levels. The resulting salt-water intrusion has forced the closure of wells in Wildwood; Cape May City, the Villas area, and threatens other areas in Lower Township and Beasley Point in Upper Township (figure 1). Shallow well pumpage has caused ground water level declines, reducing the ground-water discharge to streams and consequently reducing flow to wetlands and freshwater inputs to the coastal bays. Shallow ground water supports stream baseflow during dry periods. The reduction in streamflow and fresh water may have a deleterious impact on ecosystems. Saltwater intrusion and the depletion of surface water have caused concern about the ability of the aquifers of Cape May to be the water supply for the future.

Figure 1. Areas of current or predicted saltwater intrusion



Study Area Description

The primary source of potable water in Cape May is ground water. The five fresh water aquifers are the Holly Beach water bearing zone, Estuarine Sand, Cohansey Sand, Rio Grande water-bearing zone, and Atlantic City 800-Foot Sand. These aquifers are shown in the cross section in figure 2, which runs in a north to south direction along the spine of the Cape May peninsula. The aquifers below the Atlantic City 800-Foot Sand in Cape May only contain saline water.

Extensive, previous analyses have revealed that water for future demand in the county can come from the following sources: pumpage of fresh ground water, desalination of salty ground or surface water, water reuse, pipelines from outside of the county, and, indirectly, by a reduction of demand through conservation. *The extent to which additional ground water can be pumped from the county is a primary focus of this study*. The Atlantic City 800-Foot Sand and Cohansey sand have the most potential to supply water. Additional water will be available from the Rio Grande water-bearing zone, but its yield will be limited. Pumpage from the Cohansey aquifer and Holly Beach

water-bearing zone will be likely to adversely affect aquatic habitats during dry periods. The Holly Beach water-bearing zone also is the most vulnerable to contamination from the land surface. The Estuarine Sand does not have sufficient yield to provide much increased usage.

The analyses direct us to plan future water supplies with pumpage focused along a line of well nests along the peninsula spine north of Lower Township. These will be the safest from saltwater intrusion (Lacombe and Carleton 2002). These well nests could include wells completed in the Atlantic City 800-Foot Sand, Rio Grande water bearing zone, Cohansey, and Holly Beach aquifers. The well nests will be interconnected by pipeline to transmit water to the places of need. A conjunctive approach to pumping should be explored. Shallow wells, in the Holly Beach water-bearing zone and Cohansey sand, could be used during wetter periods where impact on the ecosystem will be lessened. Deeper wells, in the Rio Grande water bearing zone and Atlantic City 800-Foot Sand, could be used during drier periods to the extent that saltwater does not intrude. Aquifer storage and recovery systems (ASR) could be used to augment peak summer demand. The admirable level of conservation currently practiced in Cape May County should be continued. Wastewater reuse should be considered for nonpotable needs. Desalination or water by pipeline from out of the county would be considered as a last resort.

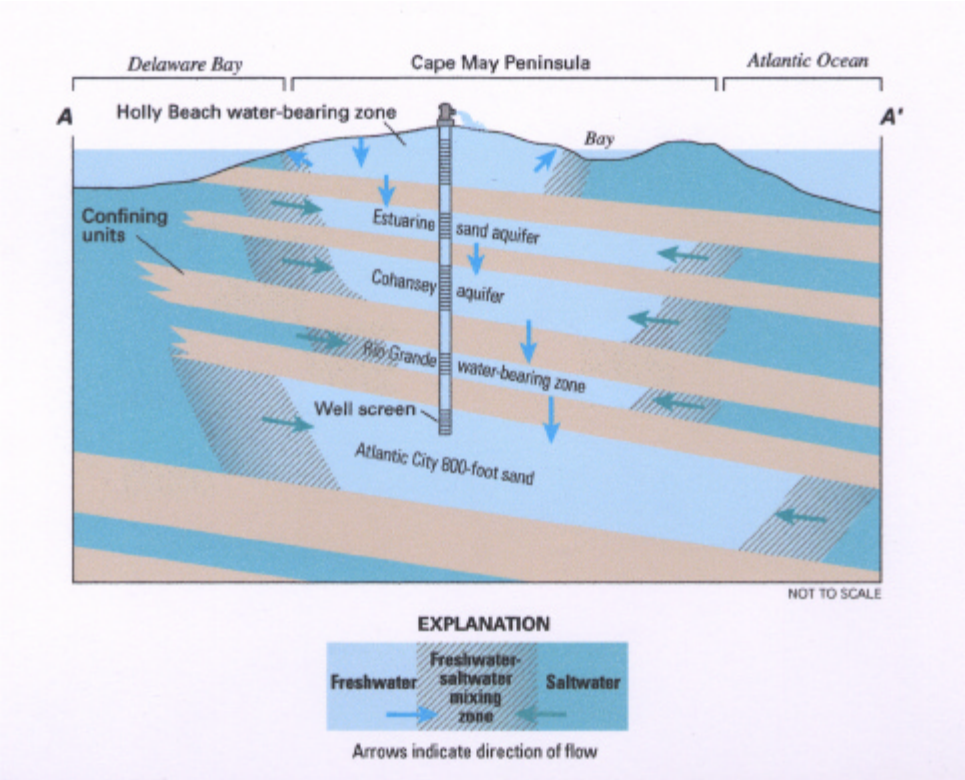


Figure 2. Hydrogeologic cross section oriented north to south along the spine of Cape May, N.J.

PROJECT OBJECTIVES

To implement this plan, various issues must be detailed and resolved; these have become the objectives of this project:

Determine future water needs of Cape May County;

Determine most feasible future well locations and areas for ASR to augment increased summer pumpage;

Establish limits of saltwater intrusion, stream depletion, and habitat impact to be used in determining acceptable pumpage rates;

Establish the timing or passing flow requirements for shallow versus deep conjunctive use;

Cost-effectively integrate wastewater reuse to supplement ground water supplies;

Develop a plan implementation schedule and system management scheme;

Develop a sustainable mechanism to monitor future conditions.

APPROACH

This project will be divided into four phases to be completed over two (2) years. These phases consolidate logical groupings of work tasks and, where possible, will be performed concurrently to reduce the project duration.

Phase 1: *Develop the detailed plans for the project and to organize the multi-agency team that will undertake the activities of the project.* This initial planning effort will be coordinated by NJDEP and USGS. A meeting will be held to discuss the plans with local stakeholders. At that time, plans for future public participation meetings will be developed. An important starting point for much of the needed analysis is the determination of the future water demand of the Cape May communities, water supply systems, and other water users such as commercial, industrial, or agricultural interests. This effort to determine the future water demand will primarily focus on input from local stakeholders. Information about population projections, zoning, build-out analysis, development plans, wastewater plans, etc. should be the source for this analysis. Of particular interest are projections for 20 years (2025) and 50 years (2055) into the future and build out scenarios. NJDEP and USGS will work with the Cape May County Planning Department to determine the future growth in the county. Also envisioned for Phase 1 is an effort by USGS to refine the understanding of prevailing hydrologic conditions and to fill in hydrologic data gaps that are crucial to determining the limitations of the hydrologic system.

Phase 2: *Develop the necessary information and tools that will provide a predictive understanding of the hydrologic, ecologic and regulatory issues that pertain to planning a sustainable water supply for Cape May.* The water demand projections will be completed, compiled, and will include

options for water conservation and reuse. An essential component of this study is the determination of the sensitivities of water-dependent ecosystems, such as those in freshwater wetlands and the brackish water/salt water bays to hydrologic changes that could result from ground-water pumpage and development. NJDEP will investigate this component and policy options on in order to set tentative regulatory policy. The ground-water models that were developed in the 1990's by USGS will be updated to account for current pumpage, and will be refined to include the explicit simulation of the Rio Grande water bearing zone, an aquifer in Cape May County that is not substantially used. NJDEP will explore and analyze regulatory policy alternatives regarding the movement of a saltwater interface, streamflow depletion, and ecosystem impact. The aim of this task is to establish the most appropriate policy tools to ensure that the sustainability goals for future plans are achieved.

Phase 3: *Integrate the water demand projections, the information about hydrologic limitations, the ecologic sensitivities, and regulatory policy considerations to define possible well locations and pumping rates for water supply production that will meet future needs while minimizing hydrologic problems and minimizing impacts to the ecosystem.* These water supply scenarios will be simulated by USGS using the ground-water models to determine the likely changes in hydrologic parameters, such as movement of the saltwater interface and streamflow depletion. These hydrologic changes will be compared to the ecological sensitivities determined in Phase 2 to determine ecological consequences and to regulatory policy objectives. An engineering firm will be brought into the process at this point to start the process of assessing the feasibility and viability of each scenario. Plans for long-term hydrologic and ecologic monitoring systems will be developed, based upon the leading scenarios. These plans could include recommended sites for installing new test or monitoring wells.

Phase 4: *Determine and rank the engineering feasibility and cost effectiveness of the leading Phase 3scenarios.* A public meeting will be held to explain the results and to solicit additional stakeholder input. A final best scenario will be chose that will become the basis for the sustainable water supply plan. The basic design for water supply facilities, which will be primarily well fields, and the related infrastructure, which will be primarily pipelines, will be developed. A report summarizing the pertinent information, tools, and findings will be developed.

The general tasks pertaining to each phase are summarized in the table below. Each task is explained in more detail in the following sections. Figure 3, located at the end of this document shows a flowchart of the tasks to indicate the interrelationships between phase and tasks.

Phase		Task	Participating Agencies
Phase 1 (Planning)	**A**	Develop detailed plans for overall project, organize and coordinate multi-agency effort; organize and coordinate public meetings	NJDEP, USGS
	B	Project water-demand for communities and/or water-supply systems for the planning period (20 yrs & 50 yrs), identify water conservation and reuse options	CMCP, Stakeholders, NJDEP, USGS, consultant
	C	Refine assessment of hydrologic conditions and fill in data gaps	USGS
Phase 2 (Develop Information and Tools)	**A**	Determine general sensitivities of freshwater wetland and brackish/salt water bay ecosystems to hydrologic changes that could result from ground-water pumpage	NJDEP
	B	Refine information and predictive ground-water models, with particular regard to saltwater intrusion in aquifers, and streamflow depletion	USGS
	C	Analyze regulatory policy alternatives regarding movement of saltwater interface, streamflow depletion, and ecosystem impact	NJDEP
Phase 3 (Develop and Test Scenarios)	**A**	Develop preliminary water-supply scenarios with respect to projected water demand, hydrology, ecology, regulatory policy	NJDEP, USGS, Stakeholders, Engineers
	B	Assess preliminary water-supply scenarios for impacts on saltwater intrusion, streamflow depletion, and ecosystem impacts	USGS
	C	Determine the specific ecological sensitivities to hydrologic changes implicit with the best scenario(s).	USFWS, NMFS
	D	Develop recommendations for long-term hydrologic and ecologic monitoring	USFWS, NMFS, USGS, NJDEP
Phase 4 (Select and Design)	**A**	Perform cost effectiveness/feasibility analysis to determine best scenario(s)	Engineers, NJDEP, Stakeholders
	B	Develop implementation plan	NJDEP, CMCBCF
	C	Develop final plans and design	Engineers, NJDEP, Stakeholders

Agency Abbreviations

CMCP: Cape May Co. Planning Department
CMCBCF: Cape May Co. Board of Chosen Freeholders
NMFS: National Marine Fisheries Service
NJDEP: New Jersey Department of Environmental Protection
USGS: U.S. Geological Survey
USFWS: U.S. Fish and Wildlife Service

The duration of the project will be approximately 2 years. A tentative timeline of the phases and tasks is shown below

CAPE MAY - Gibson Bill Project Timeline

Timeline July 2003 > September 2005	3rd QTR	4th QTR	1st QTR	2nd QTR	3rd QTR	4th QTR	1st QTR	2nd QTR	3rd QTR
Phase 1									
A. Develop Project Plans	■								
B. Cape May Demand Analysis		■	■	■					
C. Assess Hydrologic Conditions									
1. Stream discharge measurements	■	■	■						
2. Vernal pond level measurements			■						
3. Water-table measurements	■	■	■						
4. Synoptic water levels	■		■						
5. New Well Locations	■	■							
6. Well Drilling									
7. Ground-water quality		■							
8. Ground-water age dating		■							
9. Surface-water quality			■						
10. Water -use	■	■							
11. Develop GIS			■	■					
Phase 2									
A. Determine Ecosystem Sensitivity		■	■	■					
B. Refine Ground Water Models		■	■	■					
C. Regulatory Policy Alternatives		■	■	■					
Phase 3									
A. Develop Water Supply Scenarios				■	■				
B. Analyze Water Supply Scenarios					■	■			
C. Determine Ecological Sensitivities							■		
D. Develop Monitoring Plan							■		
Phase 4									
A. Cost effectiveness/feasibility study								■	
B. Implementation Plan									■
C. Final Plans & Best Scenario(s)									■

Project Work Plan

DEVELOPMENT OF A PLAN FOR SUSTAINABLE FUTURE WATER SUPPLY

FOR

CAPE MAY COUNTY, NEW JERSEY

PHASE 1 TASK A

DEVELOP PROJECT PLANS, ORGANIZE AND COORDINATE MULTI-AGENCY EFFORT; ORGANIZE AND COORDINATE PUBLIC PARTICIPATION, PREPARE FINAL REPORT ON THE FINDINGS OF THE PROJECT

(Participating Agencies: NJDEP, USGS)

Task Products:

A project plan that outlines the details required to accomplish the project objectives will be developed by NJDEP and USGS. Public hearings will be held to explain and receive comments on the work plans for this project. Public comments will be considered in framing the final conclusions and water-supply plan developed by this project. Four meetings are envisioned to both inform the public about the plans and findings of the project and to involve the technical specialists and political representatives of the County in the formulation of the water-supply plan, and thus satisfy these requirements:

Project Overview and Kickoff (Audience: general public): The project team will explain the overall plans for the project.

Formulation of Preliminary Future Water-Supply Scenarios (Audience: water purveyor representatives): The project team will meet with technical specialists from the Cape May County water purveyors to discuss and interactively fine tune the preliminary future water-supply scenarios prior to detailed modeling and analysis. This meeting will be timed to coincide with the task to prepare preliminary water-supply scenarios (Phase 3 Task A).

Formulation of Implementation Plans (Audience: representatives of the political entities of Cape May County): The tentative results of the project will be discussed, outlining the best scenario(s). Plans for final decisions and implementation of the scenario(s) will be discussed and refined. This meeting will be timed to coincide with the task (Phase 4 Task C) to develop an implementation plan.

Project Findings and Overview of Future Water supply Plan for Cape May County (Audience: general public): The findings of the project will be outlined and overview of the future water supply plan for Cape May County will be presented.

The funding legislation for this project ("Gibson Bill", P.L. 2001, Chapter 165, section 3a) requires that a report be prepared on sustainable water supply alternatives within Cape May County, but outside of the pinelands area, necessary to meet the current and future water supply needs of Cape May County while avoiding any adverse ground water or ecological impact on Cape May County. This report will be a compilation of the results of each phase of the project. The report will be published by NJDEP and made publicly available.

PHASE 1 TASK B

DETERMINE WATER-DEMAND FOR COMMUNITIES AND/OR WATER-SUPPLY SYSTEMS FOR THE PLANNING PERIOD, IDENTIFY WATER CONSERVATION AND REUSE OPTIONS

(Participating Agency: Cape May County Planning Department, Consultant)

Task Products:

A plan for sustainable water supply in Cape May requires a determination of the future need or demand for water. This will require careful consideration of available land and existing zoning of each of Cape May County's communities. This must be accomplished on a quantitative basis where each community is considered in a consistent manner. Projection of population growth, potential development, and the consequential demand for water will be estimated on a municipal level utilizing existing zoning for the 20 year (2025) and 50 year (2055) periods.

PHASE 1 TASK C

REFINE ASSESSMENT OF HYDROLOGIC CONDITIONS AND FILL IN DATA GAPS

(Participating Agency: USGS)

Task Products:

Previous investigation efforts in Cape May have advanced the state of hydrologic understanding significantly (see reference list). However, additional data collection that is critical to the County – wide assessment and necessary to support the work planned in subsequent phases of this project are listed below. This information is needed to address adverse ground water and ecological impacts and for the evaluation of alternative water supply sources including relocated wells, conjunctive aquifer use, and conjunctive use utilizing water-reuse and desalination options etc. All of these tasks are pertinent to planning future water supply.

Streamflow and Water Table Fluctuations Determinations

Detailed measurements of streamflow, pond levels and water levels in the surficial aquifer are necessary to determine hydrologic conditions and the degree of connection between shallow ground water and surface water based on seasonal climatic and man-induced stresses.

a. Fresh-water stream-discharge measurements

Fresh-water stream-discharge measurements provide a baseline for stress-induced changes in baseflow and data necessary for calibration of ground-water flow models. Fresh water stream discharge measurements at 13 streams will be measured 4 times between May and December 2003, including at least one low-flow measurement at each stream. One set of discharge measurements will be made in late August, to be combined with an August ground-water-level synoptic, and one to be made in mid to late November to be combined with the USGS 2003 Coastal Plain water-level synoptic.

b.Vernal pond level measurements

Vernal ponds are ecologically sensitive areas that can be affected by pumping-induced stresses on the water-table aquifer. Water levels in selected vernal ponds will be monitored monthly to determine their seasonal and stressed induced changes. Drive point piezometers will be installed in 3 vernal ponds in areas where public-supply wells may be causing declines in water levels in the water-table aquifer, and 3 vernal ponds in unstressed areas. Each piezometer will be about 3 feet deep. USFWS has water-table wells within the wildlife refuges in Cape May County that may be used to monitor unstressed water levels.

c. Water-table fluctuations

Climate and withdrawal induced changes in the surficial aquifer system need to be differentiated in order to understand the magnitude of each factor. Well 9-333 screened in the Holly Beach water-bearing zone shows seasonal fluctuations in water levels. This well is in the Wildwood Water Department's mainland well field and is far from any surface-water impoundments. This well is perfectly sited to show both the stresses of the climate induced water level changes and pumping induced water-level changes. A water-level recorder will be installed and maintained on this well for a 2-year period.

Three additional water-table wells will be equipped with water-level recorders at sites that are not influenced by surface water bodies. One well will be within the cone of depression in the Cohansey and Estuarine Sand aquifers, and two wells will be selected in areas not influenced by any cones of depressions in Middle Township, where water-table aquifer water-level changes are only climate induced. These data sets will allow the climate induced water-level changes to be separated from the ground-water withdrawal induced water level changes. The data will be compared with long-term water-table data from wells 1-256, 5-689, 5-1251, and 11-44.

Aquifer Water Levels – Seasonal Stressors

Water level synoptic: Seasonal ground-water levels in all Cape May aquifers are necessary for calibration of computer simulation models and to understand the seasonal climatic and pumping influences on water levels and water availability. A late summer water level synoptic of 75 to 100

wells in five aquifers will be conducted to measure the water levels during the lowest part of the annual water level cycle. Water levels from the same wells will be measured again in November as part of the 2003 Coastal Plain water level synoptic, which would be in the middle part of the water level cycle. To measure the highest water levels a third water-level synoptic will be conducted in the spring prior tree bloom.

New Wells

Owing to the sharp increase in development of new homes and businesses in Lower Township, Cape May County during the past 10 years there are many newly installed wells along the Delaware Bay shoreline. Such wells can provide valuable information on chloride concentrations and water levels in aquifer areas close, or potentially within, the saltwater front. To supplement existing data on saltwater intrusion rates a search for wells that are at least 200 feet deep and within 0.5 miles of Delaware Bay will be conducted in the Bureau of Water Allocation's well permit and well record files. Selected wells will be sampled for chloride and sodium concentrations and used for water level measurements during the water level synoptic measurements.

The USGS will oversee the drilling of at least 3 observation wells to be installed as part of NJDEP's water allocation permit program. Two wells are intended for installation in a sand pit east of the town of Villas and will be screened in the Cohansey Aquifer and the Estuarine-sand aquifer. A deep well will be drilled to the depth of 700 feet in the Reeds Beach area along Delaware Bay and will be screened in the Atlantic City 800-Foot Sand. The USGS will perform resistivity and gamma ray logging for hydrostratigraphic correlation and aquifer water quality.

Water Quality Determinations

a. Ground-water quality

Chloride and sodium (saltwater indicators) will be measured along with other selected water-quality parameters in selected shoreline wells in all 5 aquifers. The sampling of 20 wells has been completed and the results have documented the saltwater front movement to 2 wells with the remaining 18 wells not yet impacted by saltwater. Approximately 25 additional wells will be sampled.

b. Ground-water age dating

Age dating of ground water will help determine the rate of recharge to pumped aquifers and provide data for calibration of a ground-water flow model. Samples collected from 9 wells screened in the Cohansey aquifer that will be analyzed for tritium and oxygen, hydrogen, and carbon isotopes. Results from these analyses will allow the age of the ground water to be estimated. To date 6 wells have been sampled.

c. Surface water quality

The water quality of Cape May County streams needs to be assessed; knowing current water-of the streams will allow future changes to be determined. The USGS has surface water-quality data for Fishing Creek at Rt 47 (station 01411400) for 1965 and 1998-2002 and for Dennis Creek at Dennisville (station01411428) for 1998- 2000. It would be useful to collect similar surface water quality data for the upper reaches of Dias Creek, Green Creek, and Bidwell Creek. The data set

collected would be similar to data collected for the existing surface-water-quality network program, collected in conjunction with NJDEP.

Ground-Water Withdrawal Determinations and Databases

a. Water use

The USGS has compiled historical and current water level data from 1918 through 1990 on a well-by-well basis and is compiling data through 2002. Estimated projections have been made of total water use through the year 2100 based on annual increases in withdrawals of 10 to 50 million gallons per year. The development of a plan for a sustainable water supply for Cape May County requires a thorough understanding of current water use, including amount of water withdrawn, where it is stored, how it is used, who uses it, and when the water is used. To track water withdrawal from source, to use and return, a conveyance based water-use database is being constructed based on the NJWATER database. The spatial relationships involving land use, water use, streams, and aquifers are important to the development of a plan for a sustainable water supply for Cape May County. A Cape May GIS will be developed which contains land-use, land-ownership, and water-use data. Also, the GIS for the ground-water flow models of Spitz (1998) and Voronin and others (1996) is being developed for application here. GIS data from the flow models include aquifer and confining unit elevations, thicknesses, and hydrologic properties.

PHASE 2 TASK A

DETERMINE GENERAL SENSITIVITIES OF FRESHWATER WETLAND AND BRACKISH/SALT WATER BAY ECOSYSTEMS TO HYDROLOGIC CHANGES THAT COULD RESULT FROM GROUND-WATER PUMPAGE

(Participating Agency: USGS-BRD, NJDEP)

Task Products:

The freshwater wetland and brackish water bay ecosystems of Cape May are dependent on the discharge of freshwater from aquifers. These ecosystems are the basis of important facets of the area's tourist economy that includes bird watching and fishing. Reductions in the freshwater inputs that could result from hydrologic changes might modify or adversely impact these ecosystems. The general sensitivities of these ecosystems to hydrologic changes will be determined in order to set the constraints for pumping as part of the sustainable water supply plan. The basis of Ecosystem impacts will likely result from the situation where shallow-well pumping which diverts water from streams and wetlands. The predictive hydrologic modeling that will be used to assess the scenarios in subsequent phases and tasks will require that the constraints be set in hydrologic terms, such as levels of acceptable streamflow depletion or wetland water level decline.

The ecological sensitivity of wetlands to ground-water withdrawal will be examined in a study that includes: classification of wetlands by hydrologic setting, monitoring of natural fluctuations of water levels in ground water dependent freshwater wetlands, monitoring responses of surface elevation in brackish coastal wetlands, development of a wetland susceptibility index to ground

water withdrawal, and finally development of a wetland monitoring plan that can provide an advance warning of ecological changes.

Wetlands can be grouped according to many classification systems. The wetlands in Cape May County have been classified after Cowardin et al. (1979) as part of the National Wetland Inventory (NWI). Hydrogeomorphic (HGM) classification has been successfully used as a convenient way to organize groups of wetlands based on hydrologic variables, including wetland position in the landscape, dominant source of water, and hydrodynamics (Brinson 1993; Shaffer et al. 1999). Hydrogeomorphic classes have proven to be a significant organizing variable for characterizing wetland hydrology and capturing ecological differences that other classifications have not (Cole et al. 1997). While distinguishing between wetlands that receive water from the edges of lakes and streams (fringing wetlands) from wetlands that receive no input from these sources is simple, distinguishing between wetlands that are in ground-water recharge areas, wetlands in ground-water discharge areas, and wetlands disconnected from the ground-water system is not so obvious.

Normally, HGM classification of wetlands would occur one-by-one, as the dominant source of water, position in the landscape, and possibly hydroperiod information were determined for each one. In this case, the ground-water flow models developed and used in Phase 2 Task C, and Phase 3 Task B of this project, and the related GIS coverages, will enable the use of spatial analysis techniques that will determine the position in the landscape and probable source of water for many wetlands at a time, saving time and effort.

Once the suite of ground water influenced wetlands are identified, we can follow fluctuations in water level will be evaluated to determine the duration and depth of flooding seasonally in wetlands within areas of groundwater withdrawal and those in control areas not currently influenced by ground water withdrawal. Likewise, Similarly, surface elevation in brackish wetlands bywill be measurined from temporary benchmarks using a surface elevation table (SET) (Cahoon et al. 2002). We will use These data and output from existing ground-water models developed by the USGS WRD will determine wetland susceptibility to ground-water stresses.

PHASE 2 TASK B

ANALYZE REGULATORY POLICY ALTERNATIVES REGARDING MOVEMENT OF SALTWATER INTERFACE, STREAMFLOW DEPLETION, AND ECOSYSTEM IMPACT

(Participating Agency: NJDEP)

Task Products:

The determination of a sustainable water supply plan for Cape May County will require policies and regulations to implement the plan, guiding the future water supply withdrawals. These implementing policies and regulations will consider saltwater intrusion rates, streamflow depletion rates, ecosystem impact thresholds, water reuse quality criteria, restriction on the use of potable water for non-potable purposes, and restrictions on water importation or inter-basin transfer. These policies and regulations will guide the planning and evaluation of subsequent engineering scenarios in this project.

NJDEP regulation and planning program staff will meet with relevant legal and scientific experts to discuss and formulate tentative regulatory policies. If needed, policy scenarios could be developed and tested with hydrologic models or by examination of field data. The sensitivities of key Cape May Plants and animals to hydrologic changes, developed in Phase 2 Task A will be needed to establish regulatory policy about streamflow depletion and lowering of shallow aquifer water levels in and near wetland areas. Development and testing of scenarios (Phase 3 Tasks A & B) will require that specific constraints be set in order to ensure that saltwater intrusion is minimized, important ecosystems are maintained, and other relevant regulatory constraints are met.

PHASE 2 TASK C

REFINE PREDICTIVE HYDROLOGIC MODELS, WITH PARTICULAR REGARD TO SALTWATER INTRUSION AND STREAMFLOW DEPLETION

(Participating Agency: USGS)

Task Products:

The water supply issues concerning Cape May have been established using actual data measured in the field, such as water levels in wells or chloride concentrations. These data indicate that problems such as saltwater intrusion and streamflow depletion will constrain possible future increases in water supply pumpage from aquifers in Cape May. A primary need in this study, therefore, is the ability to quantitatively predict the hydrologic consequences of possible future pumping schemes in order to determine their effect on saltwater intrusion and streamflow depletion, and thereby determine the amount of pumpage that can be sustained without exceeding regulatory thresholds. Computer-based ground-water models can provide this needed predictive capability. Predictive ground-water models are available for the Atlantic City 800-Foot Sand (Voronin and others, 1996) and for the Cohansey aquifer, Estuarine Sand, and Holly Beach water bearing zone aquifers (Spitz 1998). The predictive hydrologic models will be prepared and calibrated for use. The predictive analyses of scenarios using these models will be performed under a subsequent task.

In this task, USGS will prepare the Atlantic City 800-Foot Sand model and Cohansey/Estuarine Sand/Holly Beach model for use in evaluating the potential effects of water supply pumpage on saltwater intrusion and stream depletion issues. This will include incorporating the Rio Grande water-bearing zone into Atlantic City 800-Foot Sand model, checking the calibration of both models to ground-water levels and pumpage chloride concentrations, and checking the Cohansey/Estuarine Sand/Holly Beach model calibration of stream baseflow.

[Model Details: Several ground-water models have been developed to study the aquifers of Cape May. Two, in particular, will be useful to this study, as one model does not currently exist that encompasses all of the significant aquifers with the necessary resolution. One is a model of the Cohansey Sand, Estuarine Sand, and Holly Beach aquifer developed by Spitz (1998). This model uses the SHARP model code (Essaid, 1990) to account for the difference in density between

freshwater and saltwater and how this effects the movement of ground water. This model, however, does not simulate the aquifers beneath the Cohansey. The other model, developed by Voronin and others (1996) simulates the Atlantic City 800-Foot Sand. This model uses a combination of the SHARP codes and the MODFLOW codes (McDonald and Harbaugh, 1988). At the present time, there is no model that directly simulates the Rio Grande water-bearing zone. The use of these existing models will save time and effort over the development of a new model. While these two models have been developed, several items need to be done to prepare them for the analysis required in this study. The calibration of the Spitz (1998) model needs to be checked in order to ensure that it is providing an adequate simulation of stream baseflow conditions to meet this project's requirements. Some upgrade to the calibration may be necessary. The Rio Grande water-bearing zone may be underutilized as a source of water. It will be necessary to incorporate that unit as an explicit layer in the model of the Atlantic City 800-Foot Sand (Voronin and others, 1996) in order to evaluate its capabilities and limitations. The calibration of both models should be checked against the most recent water level, chloride concentration, and pumpage data. Once these items have been accomplished the models will be ready to be used to assess pumping scenarios in a later phase and task of this study. The calibration of the models is dependent on water-level, water-use, and chloride concentration data organized in other phases. The incorporation of the Rio Grande water-bearing zone into the 800-Foot Sand model will use hydrogeologic data developed in the refine assessment of hydrologic conditions phase as well as from information derived from Lacombe and Carleton (2001) and Zapecza (1989).]

PHASE 3 TASK A

DEVELOP WATER SUPPLY SCENARIOS WITH RESPECT TO PROJECTED WATER DEMAND HYDROLOGY, ECOLOGY, REGULATORY POLICY

(Participating agencies: Cape May County Planning, USGS, NJDEP, Stakeholders, Engineers)

Task Products:

Water demand at various future timeframes and at various build-out realizations will be developed by Cape May County Planning (in Phase 1, Task B). Those water demands will need to be tentatively distributed among both existing and possible future wellfield. Using alternative sources such as desalination and water reuse will be considered. Innovative schemes such as conjunctive use of shallow and deep aquifers (minimizing surficial aquifer pumpage during dry periods, resting pumpage closer to saltwater during wet periods) need to be developed and considered. The development of plans for the distribution of water source in location and throughout the planning timeframe needs to be organized into definite scenarios. These scenarios will be developed through a meeting with key parties. These scenarios will then be evaluated with the ground-water models to determine their impact on saltwater, streamflow depletion, and ecology with respect to regulatory policy as part of Phase 3 Task B. An iterative process between development of scenarios and evaluation of impact is envisioned. The effects of water use in Atlantic County will be considered as part of this task.

Future Water Demand

The future water demand for Cape May will be developed by Cape May County Planning Department (Phase 1 Task B). This will have several realizations based on liberal and conservative growth scenarios. This demand analysis will identify water needs at their point of use. This must be converted into tentative scenarios that identify the water demand at a point of extraction, (i.e. numbers of wells, aquifer, etc.). Further consideration needs to be given to possible avenues of transmission, available land for well fields, and staging the construction of water facilities to match the pace of growth.

Scenario Development

A meeting will be organized to discuss the necessary characteristics of water supply needs based upon the results of the water demand study. The target audience of this meeting will be representatives of the water supply purveyors of Cape May County. The results of the meeting will be used to guide the project team in the development of the tentative scenarios

Once the initial suite of tentative scenarios is developed, they will be transmitted to the ground-water modeler to develop model input data sets as Phase 3 Task B.

The results of the modeling will be transmitted back to the project team for evaluation and refinement of the scenarios. Several iterations are envisioned of this iterative process to develop a final set of scenarios. A short list of best scenarios will be developed as a result of the modeling. These best scenarios will meet future needs without compromising tentative regulatory constraints.

Policy on Saltwater Movement

Policy on saltwater movement, stream depletion, and ecological impact constraints on water allocation is needed for Phase 2 Task B.

PHASE 3 TASK B

ASSESS PRELIMINARY WATER SUPPLY SCENARIOS FOR IMPACTS ON SALTWATER INTRUSION AND STREAMFLOW DEPLETION

(Participating agency: USGS)

Task Products:

Preliminary water supply scenarios developed in Phase 3 Task A will be evaluated using the ground-water models to determine impact on saltwater intrusion, streamflow depletion and general potentiometric surface effects. The future hydrologic effects of the preliminary water supply scenarios will be determined. Water supply scenarios will be evaluated for their compliance with tentative regulatory policy and other relevant water management targets.

Assessment of Water Supply Scenarios

In an iterative manner, receive scenarios form Phase 3 Task A, evaluate them as flows and then report back to the project team. Convert preliminary water supply scenarios to model input format, run models, prepare maps figures, charts indicating hydrologic effects of specific scenarios.

PHASE 3 TASK C

DETERMINE THE SPECIFIC ECOLOGICAL SENSITIVITIES TO HYDROLOGIC CHANGES IMPLICIT WITH THE BEST SCENARIO(S)

(Participating agencies: USGS-BRD, NJDEP, USFWS, NMFS)

Task Products:

The general ecosystem sensitivities will be determined in Phase 2 Task A and the preliminary scenarios will be analyzed for compliance with general regulations that protect the ecosystems. This Task will examine the best scenarios to determine if the specific scenarios compromise ecological sensitivities. This information will be used to verify that the scenarios are ecologically feasible and to develop a monitoring plan in Phase 3 Task D.

PHASE 3 TASK D

DEVELOP LONG-TERM HYDROLOGIC AND ECOLOGIC MONITORING PLAN

(Participating agencies: USGS-WRD, USGS-BRD, NJDEP)

Task Products:

A long-term hydrologic and ecologic monitoring plan will be developed to monitor conditions during implementation and operation of the water-supply system and to minimize the chances for unforeseen consequences. Existing monitoring programs will be evaluated with respect to monitoring potential, new hydrologic stresses, and their potential for ecological impacts. Additional monitoring sites to evaluate ground-water levels, ground-water quality, and streamflow will be considered. Specific ecological monitoring or sampling will be designed based upon the affected species, etc. using GIS data layers, patterns of water level and ground-water fluctuations, and elevation monitoring data.

PHASE 4 TASK A

PERFORM COST EFFECTIVENESS/FEASIBILITY ANALYSIS TO DETERMINE BEST SCENARIO(S)

(Participating agencies: Engineers, NJDEP, CMCBCF)

Task Products:

The short list of best scenarios will be evaluated to determine their cost effectiveness and feasibility. A consulting engineering firm, under contract to NJDEP, who is familiar with well construction, pipeline construction, and water resources facilities, will perform this task. This analysis will outline the costs and feasibility of the best scenarios. This task will include development of a ranking system to evaluate the scenarios. This will be delivered to Phase 4 Task B.

PHASE 4 TASK B

DEVELOP IMPLEMENTATION PLAN

(Participating agencies: NJDEP, CMCBCF, Engineers)

Task Products:

The final best water supply scenario will be selected from the short list of best scenarios based upon cost effectiveness and feasibility. A general plan for the implementation of the water supply system will be developed, including system management.

PHASE 4 TASK C

DEVELOP FINAL PLANS AND DESIGN OF BEST SCENARIO

(Participating agencies: Engineers, NJDEP, CMCBCF)

Task Products:

The engineering and logistical details will be developed for the water supply plan.

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Appendix A

TEXT OF GIBSON BILL

(2001 Assembly #658)

P.L. 2001

(Approved: July 20, 2001)

CHAPTER 165

An Act requiring the conducting of certain studies and assessments of water resources in the pinelands area and in Cape May county, and making appropriations therefore.

Be It Enacted by the Senate and General Assembly of the State of New Jersey:

1. The Pinelands Commission shall, in cooperation with the Department of Environmental Protection, Rutgers, the State University, the United States Fish and Wildlife Service and the United States Geological Survey, assess and prepare a report on the key hydrologic and ecological information necessary to determine how the current and future water supply needs within the pinelands area may be met while protecting the Kirkwood-Cohansey aquifer system and while avoiding any adverse ecological impact on the pinelands area.

2. There is appropriated to the Department of Environmental Protection from the "Water Supply Fund" created pursuant to the "Water Supply Bond Act of 1981," P.L.1981, c.261, as amended by P.L.1983, c.355 and P.L.1997, c.223, the sum of $5,500,000, which constitutes a portion of the moneys repaid to the "Water Supply Fund" as repayments of principal on loans for local projects funded under the "Water Supply Bond Act of 1981," P.L.1981, c.261, as amended by P.L.1983, c.355, for the preparation by the Pinelands Commission of the aquifer assessment and report required pursuant to section 1 of this act.

3. a. The Department of Environmental Protection shall, in cooperation with the United States Fish and Wildlife Service, the National Marine Fisheries Service and the United States Geological Survey, assess and prepare a report on sustainable water supply alternatives within Cape May county, but outside of the pinelands area, necessary to meet the current and future water supply needs of Cape May county while avoiding any adverse ground water or ecological impact on Cape May county.

b. The assessment and report required pursuant to subsection a. of this section shall incorporate a county-wide ground water hydrological assessment, a county-wide water supply cost effectiveness study, and a county-wide water supply design, which shall include, but need not be limited to, the following:

(1) Cape May County-wide alternative water supply cost effectiveness study;

(2) Cape May County-wide ground water hydrologic survey; and

(3) Cape May County-wide alternative water supply design.

c. The assessment and report required pursuant to subsection a. of this section shall also identify water conservation and re-use methods to protect the water supply of Cape May County. The studies, surveys and assessments authorized by this section shall include analyses of potential future water supply demands based on future development potential and environmental constraints within Cape May County.

d. During the assessment and the preparation of the report authorized pursuant to this section, the Department of Environmental Protection may issue approvals or allocations for increased ground water withdrawals in Cape May County only upon a finding that such new withdrawals will not accelerate salt water intrusion, lower existing stream base flow or harm ecological functions or wildlife.

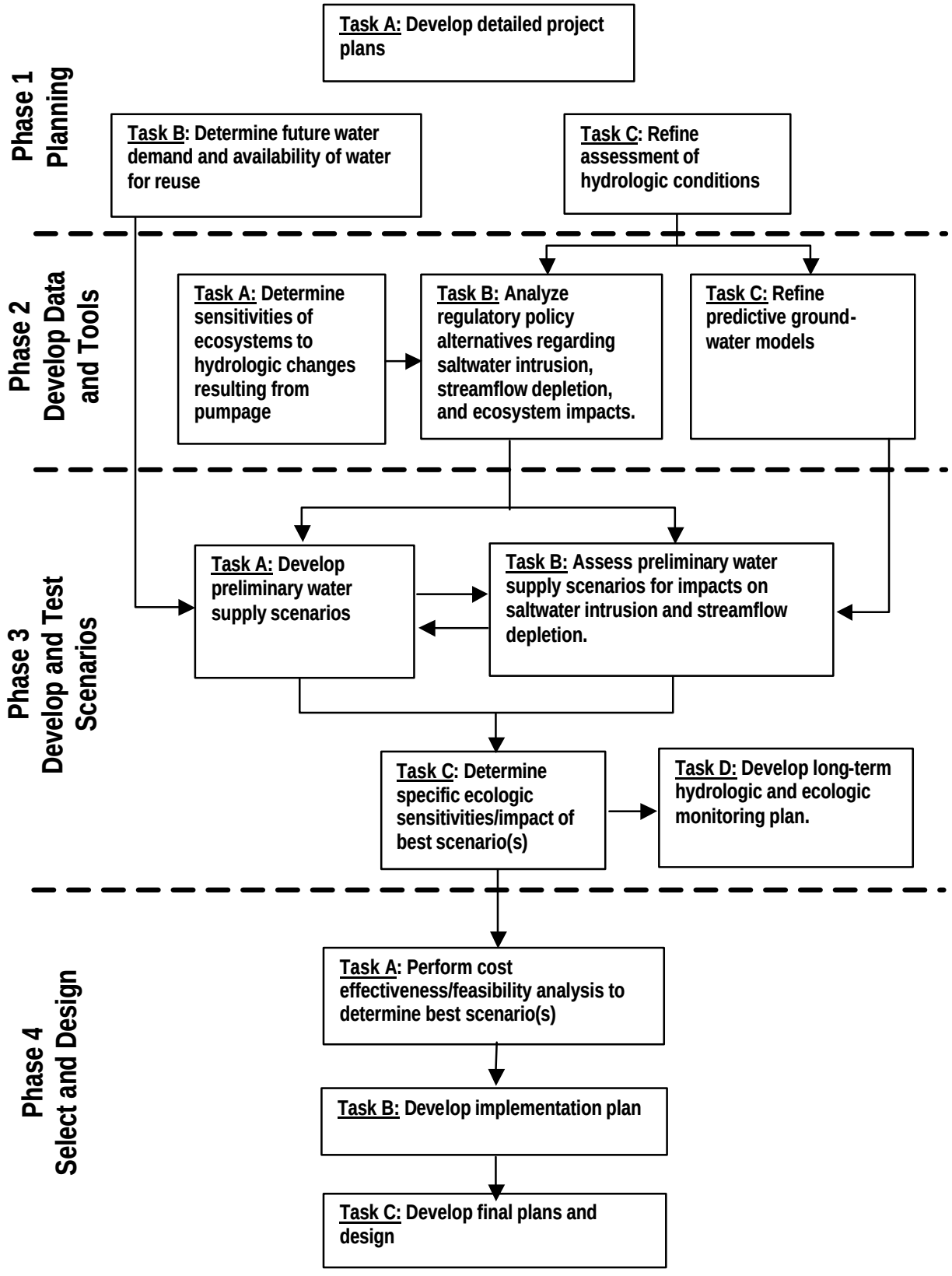
4. There is appropriated to the Department of Environmental Protection from the "Water Supply Fund" created pursuant to the "Water Supply Bond Act of 1981," P.L.1981, c.261, as amended by P.L.1983, c.355 and P.L.1997, c.223, the sum of $2,000,000 , which constitutes a portion of the moneys repaid to the "Water Supply Fund" as repayments of principal on loans for local projects funded under the "Water Supply Bond Act of 1981," P.L.1981, c.261, as amended by P.L.1983, c.355, for the preparation of the sustainable water supply alternative assessment and report required pursuant to section 3 of this act.

5. The Department of Environmental Protection and other agencies charged with performing the assessments authorized by this act shall hold one or more public hearings to explain and receive comments upon the scope of the work and research work plans for each of the studies authorized by this act. The Department of Environmental Protection and other agencies shall consider such public comments in framing the final scope of work and research plans authorized by this act.

6. This act shall take effect immediately.

Approved July 20, 2001.

Figure 3. Flow Chart of Project Phases and Tasks



Gibson Bill Cape May Project Tasks and Costs

Phase	Task	Description of Task	Participating Agencies	USGS	Cape May Co Planning	Biological Sensitivity Tasks	Engineering Firm	Drilling Monitoring Wells
	A	Develop detailed plans for overall project, organize and coordinate multi-agency effort; organize and coordinate public meetings	NJDEP, USGS					
	B	Project water-demand for communities and/or water-supply systems for the planning period (20 yrs & 50 yrs), identify water conservation and reuse options	CMCP, Stakeholders, NJDEP, USGS		$100,000			
1	C	Refine assessment of hydrologic conditions and fill in data gaps	USGS	$208,000				
	A	Determine general sensitivities of freshwater wetland and brackish/salt water bay ecosystems to hydrologic changes that could result from ground-water pumpage	NJDEP, USGS-BRD			$156,500		
	B	Analyze regulatory policy alternatives regarding movement of saltwater interface, streamflow depletion, and ecosystem impact	NJDEP					
2	C	Refine information and predictive ground-water models, with particular regard to saltwater intrusion in aquifers, and streamflow depletion	USGS	$200,000				
	A	Develop preliminary water-supply scenarios with respect to projected water demand, hydrology, ecology, regulatory policy	NJDEP, USGS, Stakeholders, Engineers	$62,000			$100,000	
	B	Assess preliminary water-supply scenarios for impacts on saltwater intrusion, streamflow depletion, and ecosystem impacts	USGS	$152,000				
	C	Determine the specific ecological sensitivities to hydrologic changes implicit with the best scenario(s).	USFWS, NMFS			$20,000		
3	D	Develop recommendations for long-term hydrologic and ecologic monitoring	USFWS, NMFS, USGS, NJDEP	$25,000		$18,000		$150,000
	A	Perform cost effectiveness/feasibility analysis to determine best scenario(s)	Engineers, NJDEP, Stakeholders				$150,000	
	B	Develop implementation plan	NJDEP, CMCBCF					
4	C	Develop final plans and design, prepare report	Engineers, NJDEP, USGS, Stakeholders	$185,000			$150,000	
				$832,000	$100,000	$194,500	$400,000	$150,000

Total
$1,676,500